

Environmental Protection Agency

Pt. 86, App. XVI

N_s = Total number of regeneration emission tests.

(Subscript “s” refers to standard test schedule)

5. Refer to table I and determine t_p at $(N_p - 2)_{prop}$ degrees of freedom and t_s at $(N_s - 2)_{std}$ degrees of freedom.

6. If $(A_{prop})^{1/2} \geq t_p / t_s \times (B_{std})^{1/2}$ the proposed plan is acceptable.

TABLE I TO APPENDIX XV

Degrees of freedom (N-2)	t
1	6.314
2	2.920
3	2.353
4	2.132
5	2.015
6	1.943
7	1.895
8	1.860
9	1.833
10	1.812
11	1.796
12	1.782
13	1.771
14	1.761
15	1.753

[62 FR 31264, June 6, 1997]

APPENDIX XVI TO PART 86—POLLUTANT MASS EMISSIONS CALCULATION PROCEDURE FOR GASEOUS-FUELED VEHICLES AND FOR VEHICLES EQUIPPED WITH PERIODICALLY REGENERATING TRAP OXIDIZER SYSTEMS CERTIFYING TO THE PROVISIONS OF PART 86, SUBPART R

(a) Gaseous-Fueled Vehicle Pollutant Mass Emission Calculation Procedure.

(1) For all TLEVs, LEVs, and ULEVs, the calculation procedures specified in Chapter 5 of the California Regulatory Requirements Applicable to the National Low Emission Vehicle Program (October, 1996) shall apply. These procedures are incorporated by reference (see §86.1).

(b) Pollutant Mass Emissions Calculation Procedure for Vehicles Equipped with Periodically Regenerating Trap Oxidizer Systems.

(1) Exhaust Emissions. (i) The provisions of §86.1777 apply to vehicles equipped with periodically regenerating trap oxidizer systems, except that the following shall apply instead of the requirements in §86.144–94(a):

(ii) The final reported test results shall be computed by the use of the following formula:

(iii) For light-duty vehicles and light-duty trucks:

$$Y_{wm} = 0.43 ((Y_{ct} + Y_s) / (D_{ct} + D_s)) + 0.57 ((Y_{ht} + Y_s) / (D_{ht} + D_s)).$$

(iv) For purposes of adjusting emissions for regeneration:

$$Re = ((Yr1 - Y_{ct}) + (Yr2 - Y_s) + (Yr3 - Y_{ht})) / (D_{ct} + D_s + D_{ht}).$$

$$Yr = Y_{wm} + Re.$$

Where:

Y_{wm} = Weighted mass emissions of each pollutant, i.e., HC, CO, NO_x or CO, in grams per vehicle mile.

Y_{ct} = Mass emissions as calculated from the “transient” phase of the cold start test, in grams per test phase.

Y_{ht} = Mass emissions as calculated from the “transient” phase of the hot start test in grams per test phase.

Y_s = Mass emissions as calculated from the “stabilized” phase of the cold start test, in grams per test phase.

D_{ct} = The measured driving distance from the “transient” phase of the cold start test, in miles.

D_{ht} = The measured distance from the “transient” phase of the hot start test, in miles.

D_s = The measured driving distance from the “stabilized” phase of the cold start test, in miles.

Yr = Regeneration emission test.

Re = Mass emissions of each pollutant attributable to regeneration in grams per mile.

$Yr1$ = Mass emissions, during a regeneration emission test, as calculated from the “transient” phase of the cold start test, in grams per test phase.

$Yr2$ = Mass emissions, during a regeneration emission test, as calculated from the “stabilized” phase of the cold start test, in grams per test phase.

$Yr3$ = Mass emissions, during a regeneration emission test, as calculated from the “transient” phase of the hot start test in grams per test phase.

(2) Particulate Emissions. (i) The provisions of §86.1778 apply to vehicles equipped with periodically regenerating trap oxidizer systems, except that the following shall apply instead of the requirements §86.145–82(a):

(ii) The final reported test results for the mass particulate (Mp) in grams/mile shall be computed as follows.

(iii) For purposes of adjusting emissions for regeneration:

$$Mp = 0.43(Mp1 + Mp2) / (D_{ct} + D_s) + 0.57 (Mp3 + Mp2) / (D_{ht} + D_s)$$

$$Re = ((Mpr1 - Mp1) + (Mpr2 - Mp2) + (Mpr3 - Mp3)) / (D_{ct} + D_s + D_{ht})$$

$$Mpr = Mp + Re$$

Where:

(1) $Mp1$ = Mass of particulate determined from the “transient” phase of the cold start test, in grams per test phase. (See §86.110–94(d)(1) for determination.)

- (2) Mp2 = Mass of particulate determined from the “stabilized” phase of the cold start test, in grams per test phase. (See § 86.110–94(d)(1) for determination.)
- (3) Mp3 = Mass of particulate determined from the “transient” phase of the hot start test, in grams per test phase. (See § 86.110–94(d)(1) for determination.)
- (4) Dct = The measured driving distance from the “transient” phase of the cold start test, in miles.
- (5) Ds = The measured driving distance from the “stabilized” phase of the cold start test, in miles.
- (6) Dht = The measured driving distance from the “transient” phase of the hot start test, in miles.
- (7) Mpr = Regeneration emission test
- (8) Re = Mass of particulate attributable to regeneration in grams/mile.
- (9) Mpr1 = Mass of particulate determined, during a regeneration emission test,

- from the “transient” phase of the cold start test in grams per test phase. (See § 86.110–94(d)(1) for determination.)
- (10) Mpr2 = Mass of particulate determined, during a regeneration emission test, from “stabilized” phase of the cold start test, in grams per test phase. (See § 86.110–94(d)(1) for determination.)
- (11) Mpr3 = Mass of particulate determined, during a regeneration emission test, from the “transient” phase of the hot start test, in grams per test phase. (See § 86.110–94(d)(1) for determination.)

(c) Fuel Economy Calculations for Gaseous Fuels Based on the Cold Start CVS–1975 Federal Test Procedure.

(1) Assume the fuel meets HD–5 specifications (95% C₃H₈, 5% nC₄H₁₀, by volume).

(i) Physical constants of Propane and Normal Butane:

Component	Mol. Wt.	Sp. Gr.	Liquid density (lb/gal @ 60 °F)	Liquid density of Hd-5 (lb/gal @ 60 °F)
C ₃ H ₈	44.094	0.508	4.235 ×	0.95 = 4.0233
nC ₄ H ₁₀	58.12	0.584	4.868 ×	0.05 = 0.2434
				4.2667

(ii) Density of the HD–5 fuel:

$$(0.95 \times 4.235) + (0.05 \times 4.868) = 4.267 \text{ lb/gal @ } 60^\circ\text{F}$$

(iii) Molecular Weights:

(A)

Species	Mol. Wt.
C	12.01115
H	1.00797
O	15.9994
CO	28.01055
CO ₂	44.00995
CH _{2.658} *	14.6903

* Average ratio of Hydrogen to carbon atoms in HD–5 fuel.

(B)

C ₃ H ₈	8/3	=	2.666×0.95 (% propane)	=	2.533
nC ₄ H ₁₀	10/4	=	2.5×0.05 (% Butane)	=	0.125
					2.568

(iv) Weight of Carbon in:

$$\text{CO} = \text{wt. of CO} \times (12.01115 / 28.01055) = \text{wt CO} \times (0.429)$$

$$\text{CO}_2 = \text{wt. of CO}_2 \times (12.01115 / 44.00995) = \text{wt CO}_2 \times (0.273)$$

$$\text{CH}_{2.658} = \text{wt. of CH}_{2.658} \times (12.01115 / 14.6903) = \text{wt CH}_{2.658} \times (0.818)$$

(v) Wt. of Carbon per gallon of LPG:

$$\text{wt. of carbon} = 4.2667 \text{ lbs/gal} \times 453.59 \text{ gms/lb} \times 0.818 = 1583 \text{ grams C/gal HD-5}$$

(vi) Fuel economy:

$$\frac{\text{grams C/gal}}{\text{grams C in exhaust/mi}} = \text{miles/gal}$$

$$\text{LPG} = \frac{1583 \text{ gms C/gal}}{(0.818)(\text{HC}) + (0.429)(\text{CO}) + (0.273)(\text{CO}_2)}$$

Where:

HC = CVS HC in grams/mile

CO = CVS CO in grams/mile

CO₂ = CVS CO₂ in grams/mile

For gasoline:

$$= \frac{2421}{(0.866)(\text{HC}) + (0.429)(\text{CO}) + (0.273)(\text{CO}_2)}$$

For Natural Gas:

$$= \frac{1535}{(0.759)(\text{HC}) + (0.429)(\text{CO}) + (0.273)(\text{CO}_2)}$$

[62 FR 31265, June 6, 1997]

APPENDIX XVII TO PART 86—PROCEDURE FOR DETERMINING VEHICLE EMISSION CONTROL TECHNOLOGY CATEGORY/FUEL REACTIVITY ADJUSTMENT FACTORS FOR LIGHT-DUTY VEHICLES AND LIGHT LIGHT-DUTY TRUCKS CERTIFYING TO THE PROVISIONS OF PART 86, SUBPART R

The following procedure shall be used by the Administrator to establish the reactivity adjustment factor for exhaust emissions of non-methane organic gases (NMOG) and establish the “methane reactivity adjustment factor” for exhaust methane emissions from